Open Access
J. Glob. Innov. Agric. Sci., 2026, 14(1):71-78
ISSN (Online): 2788-4546; ISSN (Print):2788-4538
DOI: https://doi.org/10.22194/JGIAS/26.1771
http://www.jgiass.com

Susceptibility of Selected Grape Varieties to Arthropod Infestation in Salah Al-Din Governorate, Iraq

Hind Ibrahim Al-Khazraji*

Department of Plant Protection, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq
*Corresponding author's e-mail: hind.ibrahim@coagri.uobaghdad.edu.iq

Grapevines are essential to Iraq's horticultural economy, as the Salah Al-Din region is considered the leading producer. However, grapevines are susceptible to arthropod pests, which threaten yield and quality. This study evaluated the infestation levels on Shada, Beadh Al-Hamam, and Faranci Asoud grape varieties, focusing on pest populations, associated predators, and the role of leaf nutrient content in pest resistance. Biweekly leaf samples were taken using a microscope for pest and predator checks and counts. Leaf NPK content was determined using standard chemical methods. The highest population peak of the mite *Tenuipalpus granati* was recorded at the end of August, reaching 100.27 and 156.87 individuals/leaf on the Shada and Beadh Al-Hamam varieties, respectively. Meanwhile, the Faranci Asoud variety exhibited the highest density, with 385.80 individuals/ leaf in early September. For the black vine thrips *Retithrips syriacus*, infestations occurred at the end of July, reaching 17.33, 19.07, and 26.00 insects/leaf on the Shada, Beadh Al-Hamam, and Faranci Asoud varieties, respectively. The citrus mealybug *Planococcus citri* reached 4.00, 11.67, and 7.33 insects/leaf on the same varieties by the end of September. Predators such as *Amblyseius* sp., *Chrysoperla carnea*, and *Scolothrips sexmaculatus* correlated significantly with mite and thrips populations, but not with mealybugs, this could be due to the low population density of mealybugs. Nutrient analysis revealed a strong positive correlation between nitrogen content and pest density, a non-significant positive correlation with phosphorus content, and a negative correlation with potassium content. These findings suggest that varietal differences in pest susceptibility are influenced by leaf nutrient composition and predator presence. The study demonstrates an approach to vineyard management by leveraging natural plant defenses and natural enemies to mitigate pest damage without relying on harmful chemicals.

Keyword: Grapevine, pests infestation, *Retithrips syriacus*, *Tenuipalpus granati*, biological pest control, sustainable agriculture.

INTRODUCTION

Grapevine *(Vitis vinifera)* is considered one of the important horticultural crops and is cultivated worldwide, producing various consumer products for use as fresh and manufacturing products. Farmers highly value certain varieties in specific applications due to their unique agronomic and fruit quality traits, which determine the crop's value and production cost (Alston & Sambucc, 2019). Grapes are a significant fruit crop in Iraq, accounting for 49.97% of the total fruit production during the 2021 summer season. The total grape production reached 427,356 tons. Salah Al-Din Governorate ranked first in production, contributing 69.12%, followed by Diyala and Najaf Governorates, with 19.77% and 4.08%, respectively. The remaining governorates accounted for 7.02% of Iraq's total production (Central Statistical Organization, 2021).

Fruit trees are affected by many biotic and abiotic factors, including environmental parameters, diseases, and pests. Pests are among the factors that limit fruit tree production and impact fruit quality and yield (Singh & Acevedo, 2024). Including mites and aphids (Ahmed & Al-Khazraji, 2024), Mediterranean fruit flies and whiteflies (Al-Mallo & Abdul-Rassoul, 2017; Al-Behadili et al., 2024), as well as pathogens (Juber & Al-Windawi, 2007; Yousif & Hassan, 2023; Elkhlifi et al., 2024; Asghar et al., 2024). Mani (2022) indicated that the number of pests affecting grapes can reach 100 pests in India, and the losses caused by them are estimated to be approximately 80%.

One of the significant pests affecting grapes is the black vine thrips, *Retithrips syriacus* (Thysanoptera: Thripidae). This insect is widespread in many countries, including the United States, Brazil, the Caribbean, Asia, and Africa (Al-Azzawi et

Al-Khazraji, H. I. (2026). Susceptibility of Selected Grape Varieties to Arthropod Infestation in Salah Al-Din Governorate, Iraq. *Journal of Global Innovations in Agricultural Sciences, 14*, 71-78.
[Received 7 May 2025; Accepted 18 Jul 2025; Published 3 Oct 2025]
Attribution 4.0 International (CC BY 4.0)

al., 1990; Bragard et al., 2021). The insect has been infesting for six generations per year and infests many plants, such as grapes, apples, bananas, pears, avocados, etc. The insect damages plant leaves by scratching and sucking sap, causing silvery discoloration due to feeding (Bragard et al., 2021).

Mealybugs (Hemiptera: Pseudococcidae) are significant pests that infest various economically important plants. Several species of mealybugs affect grapevines, including *Planococcus ficus*, *Nipaecoccus vastator*, and *Planococcus citri (*Hogg et al., 2020*)*. The damage caused by these insects involves the extraction of plant sap from all parts of the plant (stems, branches, leaves, and clusters) using their piercing-sucking mouthparts, leading to plant weakness and fruit deformation. Additionally, the secretion of honeydew promotes fungal growth and the accumulation of dust, negatively impacting photosynthesis (Al-Shammari & Al-Zubaidy, 2017; Hogg et al., 2020).

Grapevines are also susceptible to various mite species. In India, six mite species have been recorded on grapevines: *Tetranychus cinnabarinus*, *T. urticae*, *T. neocoledonicus*, *Eutetranychus orientalis*, *Oligonicus unicae*, and *Oligonicus mangiferus*, with *T. urticae* being the most significant. In Iraq, the mite, *Tenuipalpus granati* Sayed (Tenuipalpidae: Acariformes), infests grapevines (Karabhantanal et al., 2012). This mite is widespread in many countries, including Greece, the former Soviet Union, Egypt, and Iraq. It infects grapes and pomegranates, but it mainly affects grapes in Iraq. The various life stages of these mites are sap-sucking organisms, extracting plant sap from leaves, and in high density, they may inhabit branches and twigs (Al-Azzawi et al., 1990; Karabhantanal et al., 2012).

Natural enemies are an essential alternative to chemical pesticides and an environmental service that helps improve ecosystem resilience and contributes to sustainable agriculture. Predators play an essential role in agricultural systems as practical components of biological pest control (Rusch et al., 2015). Many predators belonging to several families, including Coccinellidae, Chrysopidae, Staphylinidae, and Carabidae, have been recorded in vineyards (Sáenz-Romo et al., 2019; Thomson & Hoffmann, 2009). Several predators belonging to many families of Studies by Duso et al. (2012) and McMurtry et al. (2013) indicated the role of the predatory mite Phytoseiidae as a biological control agent in reducing Mite infestation in vineyards. Studies have been made to understand the variation in leaf traits important in plant-insect interactions. Plants have developed a plethora of defense strategies to prevent insects from colonizing on plants.

It is well established that insects use a variety of cues to find appropriate host plants and their feeding activity is controlled by the chemical composition and morphology of the plants, ultimately affecting insect growth and reproduction (Salerno et al., 2020; War et al., 2020). The population density of some pests and their natural enemies on various grape cultivars was evaluated in the present research. It also investigated how the leaf NPK nutritive value affects the density of pests and the plant's resistance to pests.

MATERIALS AND METHODS

***Insect sampling*:** This study was carried out on a grape orchard in Salah al-Din Governorate, Iraq, involving three grape (Vitis vinifera) cultivars viz., Shada, Beadh Al-Hamam, and Faranci Asoud. The objectives of the study were to determine the pest density of mites, black vine thrips, and citrus mealybug and to calculate the natural enemies associated with them. Divide the orchid into three units, and each unit includes Fifteen grapevines were chosen from each grape variety, and each selection was divided into three replications (5 grapevines per replicate). The experiment was laid out as a randomized complete block design. To estimate pest population density, random samples were collected every two weeks from April (coinciding with the onset of leaf Emergence through the end of November (marking the end of the grape harvest). Six leaves were collected from each vineyard in different directions, totaling 30 leaves. The leaves were placed in labeled polyethylene bags indicating the grape variety and replicate number. Samples were then transported to the laboratory, where they were examined under a light microscope to count nymphs and adults of each pest species.

***Estimation of predatory population density*:** The population density of predators associated with the pests was estimated using the same leaf samples collected to assess pest density across different grape varieties. Predators were counted per six leaves during microscopic examination. The correlation coefficient (r) between the average number of pests and the average number of predators was also calculated.

Determination of nitrogen, phosphorus, and potassium contents in leaves: Before the flowering of different varieties, the leaves of the plants were randomly collected from the upper part of the vineyards. The leaves were thoroughly washed with water to remove dust and then dried at 40°C in an oven. After drying, they were finely ground and stored in labeled polyethylene bags according to the grape variety until use. The samples had an acid digestion, where 0.2 grams of each sample were digested by separate addition of sulphuric acid and perchloric acid. Further analyses included the determination of nitrogen (N), phosphorus (P), and nutrients such as potassium (K). N was quantified by distillation in a MicroKjeldahl apparatus after the addition of sodium hydroxide (NaOH). Phosphorus (P) content quantification was carried out using an ultraviolet (UV) spectrophotometer at a wavelength of 882 nm, with ammonium molybdate that was reduced to molybdenum by ascorbic acid. Flame photometer was used to estimate potassium (K). Correlation

of NPK leaves contents with average number of pests was found as well (Al-Sahaf, 1989).

***Statistical analysis*:** Data was analyzed with the statistical package GenStat (version 12). The trials were implemented according to Randomized Complete Block Design (RCBD). All values were analyzed by one-way analysis of variance (ANOVA). Mean comparisons were made with the least significant difference (LSD) test and $p < 0.05$ was considered statistically significant. Additionally, the correlation coefficient (r) was calculated.

RESULTS AND DISCUSSION

***Susceptibility of some grape varieties to pest infestation*:** The results presented in Table 1 indicate that the various stages of the mite *Tenuipalpus granati* first appeared on the Shada variety at the onset of leaf formation, with initially low population densities. The density reached 0.33 individuals/leaf on April 9, 2023. Subsequently, the population density increased, peaking at 100.27 individuals/leaf on August 27. The population gradually decreased to 7.39 individuals per leaf by October 22 and 3.00 individuals /leaf by November 19. The first appearance of the black vine thrips was recorded on April 23, with a population density of 0.33 insects/leaf. The citrus mealybug first appeared on May 7, with a 1.33 insect/leaf density. The highest population densities for thrips and mealybugs were 17.33 and 4.00 insects/leaf, respectively, on July 30. The population then decreased to 2.33 and 1.00 insects/leaf for thrips and mealybugs, respectively, on October 22. Both insects disappeared from the grapevine by November 19. The highest average pest population on the grapevine was recorded on August 27, with a density of 36.53 pests/leaf.

Table 1. Population density of some pests on the Shada variety.

Date	Population density of Pests/leaf			Mean
	T. granati	*R. syriacus*	*P. citri*	
09/04/2023	0.33	0.00	0.00	0.11
23/04/2023	3.00	0.33	0.00	1.11
07/05/2023	4.00	3.33	1.33	2.89
21/05/2023	13.00	9.00	2.33	8.11
04/06/2023	9.33	5.33	2.67	5.78
18/06/2023	6.67	4.33	3.00	4.66
02/07/2023	21.53	11.67	2.33	11.84
16/07/2023	37.93	13.00	3.33	18.09
30/07/2023	67.53	17.33	4.00	29.62
13/08/2023	70.87	11.00	1.33	27.73
27/08/2023	100.27	9.00	0.33	36.53
10/09/2023	85.83	7.33	0.33	31.17
24/09/2023	28.47	10.00	4.00	14.16
08/10/2023	22.67	4.00	2.67	9.78
22/10/2023	7.39	2.33	1.00	3.57
5/11/2023	6.67	2.00	0.66	3.11
19/11/2023	3.00	0.00	0.00	1.00
Mean	28.73	6.46	1.72	12.30
LSD (0.05); Date = 7.88; Pests = 3.52; Date× Pests =13.66				

Pests began to appear on the Beadh Al-Hamam variety on April 23, with the population density initially low (Table 2). There were 2.67 individuals/leaf for the mite and 1.33 insects/leaf for the black vine thrips, with no significant $p > 0.05$ differences between the two pests. The citrus mealybug first appeared on September 7, with a population density of 3.67 insects/leaf. The pest populations then gradually increased, reaching 156.87 individuals/leaf for the mite on August 27 and 19.67 and 5.67 insects/leaf for thrips and mealybugs, respectively, on July 30, with significant differences between the two insects. The mite population gradually decreased, reaching 9.07 individuals/leaf on October 22 and 8.33 individuals/leaf on November 19. As for thrips and mealybugs, there was a fluctuation and decrease in their populations coinciding with the increase in mite populations, possibly due to competition between the pests. On October 22, the pest populations reached 3.33 and 1.67 insects/leaf, respectively; on November 19, they were 3.00 and 1.00 insects/leaf, respectively. The results also indicated that the highest average pest density was 55.62 pests/leaf on August 27.

Table 2. Population density of some pests on Beadh Al-Hamam variety.

Date	Population density of Pests/leaf			Mean
	T. granati	*R. syriacus*	*P. citri*	
09/04/2023	0.00	0.00	0.00	0.00
23/04/2023	2.67	1.33	0.00	1.33
07/05/2023	0.33	5.33	3.67	3.11
21/05/2023	7.33	7.33	1.67	5.44
04/06/2023	14.00	5.33	4.33	7.89
18/06/2023	22.67	12.33	5.00	13.33
02/07/2023	23.73	14.00	3.33	13.69
16/07/2023	76.93	14.33	4.67	31.98
30/07/2023	97.27	19.67	5.67	40.87
13/08/2023	126.27	15.33	2.00	47.87
27/08/2023	156.87	9.33	0.67	55.62
10/09/2023	130.60	9.00	0.33	46.64
24/09/2023	94.03	15.00	11.67	40.23
08/10/2023	26.40	7.33	4.00	12.58
22/10/2023	19.07	4.33	2.67	8.69
5/11/2023	12.67	3.33	1.33	5.77
19/11/2023	8.33	3.00	1.00	4.11
Mean	48.18	8.60	3.05	19.95
LSD (0.05); Date=14.01; Pests=6.26; Date×Pests=24.26				

As shown in Table 3, on April 23, the population densities on the Faranci Asoud variety were 0.67 individuals per leaf for mites, 0.00 insects per leaf for black vine thrips, and 0.33

insects per leaf for citrus mealybugs, with no significant ($p > 0.05$) differences observed among the pest species. The pest populations then increased, reaching 385.80 individuals/leaf for the mite on October 10. The highest density for thrips was 26.00 insects/leaf on July 30, and the highest density for mealybugs was 7.33 insects/leaf on September 24. The pest population gradually decreased, reaching 20.89 individuals/leaf for the mite, 4.33 insects/leaf for thrips, and 2.67 insects/leaf for mealybugs on October 22. On November 19, the densities were 18.00, 2.00, and 2.67 pests/leaf for the three pests, respectively. The table shows that the highest average pest density was 132.82 pests/leaf on September 10.

Table 3. Population densities of some pests on the Faranci Asoud variety.

Date	Population density of Pests/leaf			Mean
	T. granati	*R. syriacus*	*P. citri*	
09/04/2023	0.67	0.00	0.33	0.33
23/04/2023	4.00	0.33	0.00	1.44
07/05/2023	3.00	2.67	2.33	2.67
21/05/2023	8.00	12.33	3.33	7.89
04/06/2023	15.00	6.33	5.33	8.89
18/06/2023	25.33	8.00	6.00	13.11
02/07/2023	38.80	15.67	4.33	19.60
16/07/2023	84.80	15.33	5.67	35.27
30/07/2023	210.87	26.00	6.33	81.07
13/08/2023	275.87	19.33	3.33	99.51
27/08/2023	269.47	12.33	1.33	94.38
10/09/2023	385.80	11.00	1.67	132.82
24/09/2023	117.37	19.33	7.33	48.01
08/10/2023	50.22	7.00	6.00	21.07
22/10/2023	35.89	5.33	4.67	15.29
5/11/2023	27.67	3.00	3.33	11.33
19/11/2023	18.00	2.67	2.00	7.55
Mean	92.39	9.80	3.72	35.30
LSD (0.05); Date=15.70; Pests=7.02; Date×Pests=27.19				

Figure 1 illustrates that the Shada variety was the least susceptible to infestation by the pests. The average population densities were 28.73 individuals/leaf for mite, 6.46 insects/leaf for black vine thrips, and 1.76 insects/leaf for citrus mealybugs. The statistical analysis results indicated significant differences for the mite, thrips, and mealybugs. The total average population density of the Beadh Al-Hamam variety was 48.18 individuals/leaf, 8.60 insects/leaf for thrips, and 3.05 insects/leaf for mealybugs. There were significant differences ($p < 0.05$) between the population density of the mite and the other pests. The results also show that the Faranci Asoud variety was the most susceptible to pest infestation, with population densities of 92.39 individuals/leaf for mite, 9.80 insects/leaf for thrips, and 3.72 insects/leaf for mealybugs. There were differences ($p < 0.05$) among the pests. Al-Azzawi et al. (1990) reported that the population of *Tenuipalpus granati* on grapevines at Baghdad Governorate, Iraq had increased until May, then decreased during summer from June to late July and increased in August until the end of October.

The findings of the current study are in line with Abdul-Nour et al. (2017) tested for differences in PS intervals between Planococcus ficus mealybug nymphs population densities on grapevines in 2020.

Based on this the authors contribute the results to climatic conditions by finding more insects with higher temperatures. Nevertheless, temperatures over 42 °C at the end of September had a negative effect on insect development and resulted in mortality followed by decline in its populations. In an investigation by Awaid and Jawad (2018) on the assessment of some grape cultivars susceptibility towards R. syriacus infestation on grapevine in Babylon Governorate of Iraq, it found that R. syriacus infestation started in May at low infestation level and subsequently increased. Summer Royal was the most susceptible cultivar to infestation compared to Crimson seedless and the least preferable cultivar attacked by the thrips was Brenster.

The researchers attributed this to differences in the structural characteristics of the plant. The leaves of the Brenster variety have trichomes that hinder the access of insect mouthparts to the bark vessels for sap absorption, unlike the Summer Royal variety, which lacks trichomes. Reddy et al. (2020) observed that the highest population density of the thrips *Rhipiphorothrips cruentatus* on grapevines occurred during the flowering stage, followed by a decrease after fruit set and with the progression of leaf age.

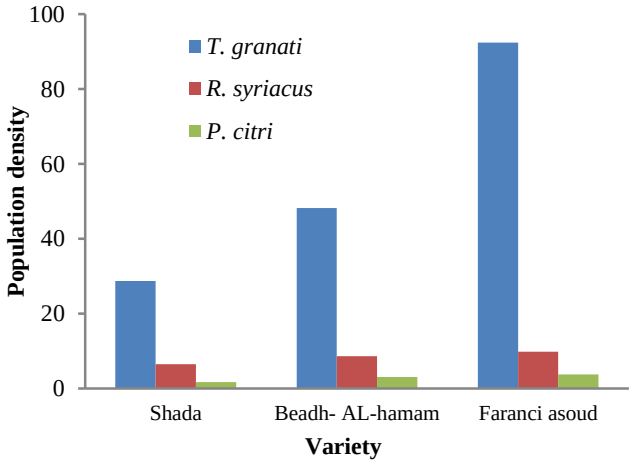

Figure 1. Susceptibility of grape varieties to different pest infestations.

Population density of predators associated with pests on grape varieties: The results in Figure 2 indicate that the first appearance of natural enemies (predators) on the Shada variety was during the first week of May, with a low population density reaching 1 predator/6 leaves for each of

Amblyseius sp., *Crysoperla* carnea, and *Scolothrips sexmaculatus*. The predator populations then gradually increased with the increase in pest populations, reaching their peak on August 27, 2023, with 11, 9, and 5 predators/6 leaves for the three predators, respectively. Subsequently, the predator populations declined. The last appearance of Amblyseius sp. and Chrysoperla carnea was recorded on October 22, with population densities of 2 and 1 predators /6 leaves, respectively. The previous appearance of *S. sexmaculatus* was on October 8, with a population density of 1 predator/6 leaves. This suggests that *Amblyseius* sp. and *S. sexmaculatus* have three peaks: the first in the second half of June, the second in July, and the third in August. *Crysoperla* carnea had a single peak in the second half of August.

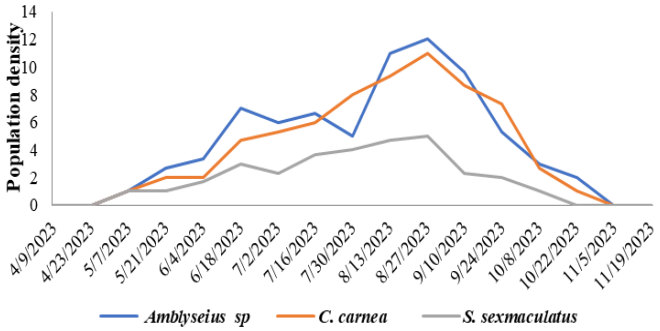

Figure 2. Population density of predators on the Shada variety.

There was a highly significant positive correlation between the population density of mite and the three predators, respectively, as shown in Table 4. There was also a highly significant positive correlation between the population density of the black vine thrips and the three predators, as the predator populations increased with the increase in pest populations. However, the correlation between the mealybug population and *C. carnea* was not significant ($p > 0.05$), and there was no correlation between the mealybug population and *Amblyseius* sp. or *S. sexmaculatus*, as these predators do not prey on mealybugs. The results in Table 4 showed that the correlation between the mite population densities and the black vine thrips and the recorded predators was positive and highly significant. However, the correlation between the mealybug population density and *C. carnea* was negative and insignificant ($p > 0.05$), and there was no correlation between the mealybug population density and *Amblyseius* sp. or *S. sexmaculatus*.

The results in Figure 3 demonstrate that the predators appeared on the Beadh Al-Hamam variety, with the first appearance occurring on April 9, with low population densities of 0.67 and 1 predator/6 leaves for *Amblyseius* sp. and *C. carnea*, respectively. *Scolothrips sexmaculatus* appeared on April 27. The predator populations increased alongside the rising pest populations, reaching their peak on September 10, with densities of 21 and 20 individuals/ 6 leaves for *Amblyseius* sp. and *Chrysoperla carnea*, respectively. The highest density for *S. sexmaculatus* was 6 predators/6 leaves on July 30 and August 13. Subsequently, the predator population decreased, reaching 2 predators/6 leaves for *Amblyseius* sp. The last appearance of *C. carnea* and *S. sexmaculatus* was on November 5, with a population density of 1 predator/6 leaves for both predators. The results also indicated that *Amblyseius* sp. had two peaks: the first in the second half of July and the second in the first half of September. *Chrysoperla carnea* had three peaks: the first in the second half of June, the second in the first half of September, and the third in October. *Scolothrips sexmaculatus* had one peak in the second half of July.

Table 4. The correlation coefficients between pests and predators on the grape varieties.

Predator	*T. granati*	*R. syriacus*	*P.* citri
Correlation coefficient on the Shada variety			
Amblyseius sp.	0.802**	0.653**	-
Chrysoperla carnea	0.799**	0.730**	0.292N.S
Scolothrips sexmaculatus	0.706**	0.797**	-
Correlation coefficient on the Beadh Al-Hamam variety			
Amblyseius sp.	0.768**	0.568**	-
Chrysoperla carnea	0.872**	0.540**	-0.032N.S
Scolothrips sexmaculatus	0.639**	0.825**	-
Correlation coefficient on the Faranci Asoud variety			
Amblyseius sp.	0.792**	0.829**	-
Chrysoperla carnea	0.887**	0.645**	0.100N.S
Scolothrips sexmaculatus	0.832**	0.634**	-

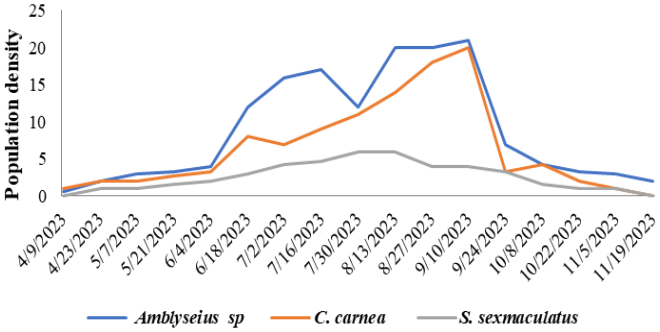

Figure 3. Population density of predators on the Beadh Al-Hamam variety.

As shown in Figure 4, predators first appeared on the Faranci Asoud variety on April 9, with population densities of 1.00, 1.00, and 0.67 individuals/6 leaves for the three predator species, respectively. The predator population gradually increased, reaching their highest densities on September 10, with 25 and 22 predators/6 leaves for *Amblyseius* sp. and *C. carnea*, respectively. The highest density for *S. sexmaculatus* was 11 predators/6 leaves on August 27. The results also showed that *Amblyseius* sp. and *C. carnea* had one peak in the first half of September, while *S. sexmaculatus* had two peaks,

one in the second half of May and the other in August. The correlation study showed a highly significant positive correlation between the mite's population densities, the black vine thrips, and the three predators (Table 4). However, there was a non-significant correlation between the mealybug population density and *C. carnea*. Raising awareness among farmers about the importance of natural enemies as a biological pest control method and providing extension services are priorities to achieve a more environmentally friendly approach, aiming to protect agricultural products and build sustainable pest management, thereby reducing the use of pesticides.

Wang et al. (2022) reported that some thrips species have developed predatory behaviors, including a diverse prey range that includes whiteflies, thrips, scale insects, mites, and beetle and moth eggs, particularly the predator *Scolothrips* sp., making them effective biological control agents in pest management. Lopez (2023) demonstrated the efficiency of the predator *Amblyseius swirskii* as a biological control agent, used as part of integrated pest management programs for various pests, including whitefly, thrips, and mites, and it is one of the most widespread predators in the world. In addition, it was found that the survival and population development of Amblyse- ius swirskii are enhanced when many prey or food sources are present (Lopez et al., 2017). Haviland et al. (2021) found a positive relationship between the predatory thrip Scolothrips sexmaculatus and the mite (Tetranychus pacificus), with two peaks in the summer and autumn in almond orchards in California, associated with an increase of mite density.

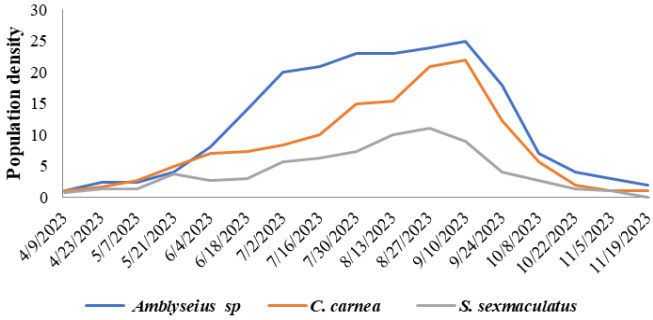

Figure 4. Population density of predators on the French black variety.

***Percentage of NPK nutrients in grape leaf varieties*:** It was also observed that there are differences in the percentages of NPK in the nutrient among the varieties of grapes, based on Table 5. Minimum percentages of nitrogen were observed and recorded 16.33% in Shada genotype and 34% in Bradh Al-Hamam genotype. The variety with the maximum nitrogen content had a level of 38% in the Faranci Asoud. Phosphorus content was 8, 10 and 11% for the Shada, Beadh Al-Hamam and Faranci Asoud, respectively. The highest potassium percentage was recorded in the Shada variety at 24%, while it was 19.33% in the Beadh Al-Hamam variety, and the lowest at 14% in the Faranci Asoud variety. The statistical analysis results indicated significant ($p < 0.05$) differences among the varieties regarding the concentration of the different compounds. Also, an important and positive correlation between the nitrogen percentage and the pest's population density was observed in the other varieties. An increase in leaf nitrogen content promotes vegetative growth, making the plant tender and soft, facilitating the penetration of pest mouthparts and feeding. This may explain the pests' nutritional preferences and higher population densities on the Faranci Asoud variety. The correlation coefficient was insignificant with phosphorus and was significantly negative between potassium percentage and pests' population density in the different varieties. It can be inferred that increasing the potassium content in plant leaves enhances the plant's resistance to pests and reduces insect infestation by altering the composition and quality of the host plant. One of the functions of calcium is to enhance plant resistance by thickening and strengthening cell walls through forming the middle lamella and calcium pectate, making tissue penetration more difficult and thus acting as a physical barrier against pests (Al-Sahaf, 1989). Similarly, potassium levels showed an inverse relationship with Petrobia tritici mite populations on wheat (Kalmosh et al., 2024). Low nitrogen in strawberry plants was reported to decrease Tetranychus urticae populations (Alizade et al., 2016). The findings of this study align with earlier studies, which have noted that increasing the nitrogen percentage in plants positively influences the rise of pest populations.

Table 5. Nutrient percentage in grape leaf varieties.

Variety	Mean no. of pest	Nutrient percentage (%)		
		N	P	K
Shada	12.30	16.33	8.00	24.00
Beadh Al-hmam	19.95	34.00	10.00	19.33
Faranci Asoud	35.30	38.00	11.00	14.00
Correlation coefficient		0.967**	0.400	-0.755
LSD (0.05)		6.139	2.710	3.778

***Conclusion*:** This study also highlighted the complexity of the correlation between susceptibility of different grape varieties to pest and mite attack and the presence of natural enemies (predators) during sampling period. The results of this study indicated that grape type is suffering from the infestation of pests to different extent, from high infestation variety such as Faranci Asoud to the low one like Beadh Al-Hamam and Shada. This variation can be as a result of genotypic-nutritional, and chemical interactions of varieties involved, and in regard to the environment where studies were conducted including presence of predators alongside other factors. The results of the relationship between pest population density and NPK levels in the leaves of the grape

variety shed light on how nutrient management affects the dynamics of pest. Thus, balancing NPK levels in leaves may improve plant resistance and promote a more favorable environment for natural predation. These results underline the importance of integrated pest management, not just the complex biological interplay that occurs in the grape environment, but also the role of nutrient management in conferring resistance to a range of grapevine diseases. Further research is required to investigate the impact of these relationships on the long-term effects and whether this can serve as a basis for sustainable viticulture without chemical pesticide application and favouring natural pest management.

***CRediT author statement*:** The author is responsible for all aspects of this research, including conceptualization, methodology, data collection, analysis, visualization, and original draft preparation, as well as review and editing.

***Acknowledgments*:** The authors would like to thank farmer Jasim Mohammed for his cooperation, as well as Dr. Qasim Hussein and Dr. Ammar Amjad from the College of Agricultural Engineering Sciences for their valuable support.

***Conflict of interest*:** The authors declare no conflict of Interest.

***Ethical statement*:** This article does not contain any studies which require ethics committee approval.

***Availability of data*:** All relevant data are contained within the manuscript.

***Consent to participate*:** N/A

***Consent for publication*:** The authors submitted consent to publish this research manuscript in JGIAS

***SDGs addressed*:** No poverty; Zero hunger; good health and well-being.

***Policy referred*:** Sustainable agriculture; Organic production.

***Publisher's note*:** All claims stated in this article are exclusively those of the authors and do not necessarily represent those of their affiliated organizations or those of the publisher, the editors, and the reviewers. Any product that may be evaluated/assessed in this article or claimed by its manufacturer is not guaranteed or endorsed by the publisher/editors.

REFERENCES

Abdul Nour, A., Nemur, D., & Awda, B. (2021). Study of the seasonal abundance of grapevine mealybug *Planococcus ficus* S. in Homs province. *Journal of Al-Baath University, 43*, 131-158.

Ahmed, F. M., & Al-khazraji, H. I. (2024). Seasonal abundance of aphids on apple cultivars and their chemical control. *IOP Conference Series: Earth and Environmental Science, 1371*, 032002.

Al-Azzawi, A. F., Qadu, I. K., & Al-Haidari, H. S. (1990). *Economic entomology*. Dar El Hekma for Printing & Publishing, Ministry of Higher Education and Scientific Research, Iraq.

Alizade, M., Hosseini, M., Awal, M. M., Gol-dani, M., & Hosseini, A. (2016). Effects of nitrogen fertilization on population growth of two-spotted spider mite. *Systematic and Applied Acarology, 21*, 947-956.

Al-Behadili, F., Ahmed, Q., Al-shuwalli, T., Li, B., & Ren, Y. (2024). Diminish the chances of Mediterranean fruit fly *Ceratitis capitata* eggs surviving by suppressing the expression of the heat shock protein 27 gene (Hsp27). *Tikrit Journal for Agricultural Sciences, 24*, 1-13.

Al-Mallo, I., & Abdul-Rassoul, M. S. (2017). Host plants and distribution of some white flies' species (Hemiptera, Aleyrodidae) in the middle of Iraq. *Bulletin of the Iraq Natural History Museum, 14*, 295-300.

Al-Sahaf, F. H. (1989). *Applied plant nutrition*. Ministry of Higher Education and Scientific Research, Iraq.

Al-Shammari, H. J., & Al-Zubaidy, H. K. (2017). Growth threshold and degree days' requirement for development and growth of citrus mealy bug *Planococcus citri* (Risso), Hemiptera: Pseudococcidae. *The Iraqi Journal of Agricultural Sciences, 48*, 501-506.

Alston, J. M., & Sambucci. (2019). Grapes in the world economy. In D. Cantu & M. Walker (Eds.), *The grape genome: Compendium of plant genomes*. Springer, Cham.

Asghar, F., Ahmad, I., Mannan, A., Bozhuyuk, M.R., Moale, C., & Hakimi, F. (2024). Influence of cucurbitaceae rootstocks on growth, yield and quality of grafted cucumber. *Journal of Horticultural Science and Technology, 7*, 38-42.

Awaid, N. A., & Jawad, A. M. (2018). An environmental and life study of *Retithrips syriacus* Mayet (Thripidae: Thysanoptera) in Babylon. *Journal of University of Babylon for Pure and Applied Science, 10*, 94-110.

Bragard, C. F., Gonthier, P., Miret, J. A. J., Justesen, A. F., Magnusson, C. S., Milonas, P., Navas-Cortes, J. A., Parnell, S., Potting, R., Reignault, P. L., Thulke, H., Van der Werf, W., Civera, A. V., Yuen, J., Zappalà, L., Gregoire, J., Malumphy, C., Czwienczek, E., Kertesz, V., Maiorano, A., & MacLeod, A. (2021). Pest categorisation of *Retithrips syriacus*. *EFSA Journal, 19*, e06888.

Central Statistical Organization. (2021). *Summer fruit tree production report*. Ministry of Planning, Directorate of Agricultural Statistics, Baghdad, Iraq.

Duso, C., Pozzebon, A., Kreiter, S., Tixier, M. S., & Candolfi, M. (2012). Management of phytophagous mites in European vineyards. In N. J. Bostanian, C. Vincent, & R.

Isaacs (Eds.), *Arthropod management in vineyards* (pp. 191-217). Springer.

Elkhlifi, F., Elbakkali, M., Chetto, O., Talha, A., Benkirane, R., & Benyahia, H. (2024). Variability analysis of the Phenotypic Characteristics of some Grapefruit and Pomelo under Moroccan Conditions. *Journal of Global Innovations in Agricultural Sciences, 12*, 263-275.

Haviland, D. R., Rill, S. M., & Gordon, C. A. (2021). Field biology of *Scolothrips sexmaculatus* (Thysanoptera: Thripidae) as a predator of *Tetranychus pacificus* (Acari: Tetranychidae) in California almonds. *Journal of Economic Entomology*, *114*, 1111-1116. https://doi.org/10.1093/jee/toab036

Hogg, B. N., Cooper, M. L., & Daane, K. M. (2021). Areawide mating disruption for vine mealybug in California vineyards. *Crop Protection, 148*, 105735.

Juber, K. S., & Al-Windawi, D. S. J. (2007). Evaluation of some chemicals in protecting apple seedlings from some pathogenic soil fungi. *The Iraqi Journal of Agricultural Sciences, 38*, 41-51.

Kalmosh, F.S., Ibrahim, M. M. A., Lv, J., Saleh, I. A., Al-Hawadie, J. S., & Al-Qahtani, W. H. (2024). Effect of different fertilization strategies on infestation of brown wheat mite and wheat productivity. *Agronomy*, *14*, 2428. https://doi.org/10.3390/agronomy14102428

Karabhantanal, S. S., Udikeri, S. S., Vastrad, S. M., & Wali, S. Y. (2012). Bioefficacy of different acaricides against red spider mite, *Tetranychus urticae* on grapes. *Pest Management in Horticultural Ecosystems, 18*, 94-97.

Lopez, L. (2023). Meet *Amblyseius swirskii* (Acari: Phytoseiidae): A commonly used predatory mite in vegetable crops. *Journal of Integrated Pest Management, 14*, 1-10.

Lopez, L., Smith, H. A., Hoy, M. A., & Cave, R. D. (2017). Dispersal of *Amblyseius swirskii* (Acari: Phytoseiidae) on high-tunnel bell peppers in presence or absence of *Polyphagotarsonemus latus* (Acari: Tarsonemidae). *Journal of Insect Science, 17*, 1-7.

Mani, M. M. (2022). Pests of grapevine and their management. In M. Mani (Ed.), *Trends in horticultural entomology* (pp. xx-xx). Springer.

McMurtry, J. A., Moraes, G. J., & Sourassou, N. F. (2013). Revision of the lifestyles of phytoseiid mites (Acari: Phytoseiidae) and implications for biological control strategies. *Systematic and Applied Acarology, 18*, 297-320.

Reddy, A. J., Saindane, Y. S., Datkhile, R. V., & Deore, B. V. (2020). Seasonal incidence of grapevine thrips and their correlation with weather parameters. *Journal of Entomology and Zoology Studies, 8*, 1170-1173.

Rusch, A., Birkhofer, K., Bommarco, R., Smith, H. G., & Ekbom, B. (2015). Predator body sizes and habitat preferences predict predation rates in an agroecosystem. *Basic and Applied Ecology, 16*, 250-259.

Salerno, G., Rebora, M., Piersanti, S., Gorb, E., & Gorb, S. (2020). Mechanical ecology of fruit-insect interaction in the adult Mediterranean fruit fly *Ceratitis capitata* (Diptera: Tephritidae). *Zoology, 139*, 125748.

Sáenz-Romo, M. G., Veas-Bernal, A., Martínez-García, H., Campos-Herrera, R., Ibáñez-Pascual, S., Martínez-Villar, E., Pérez-Moreno, I., & Marco-Mancebón, V. S. (2019). Ground cover management in a Mediterranean vineyard: Impact on insect abundance and diversity. *Agriculture, Ecosystems & Environment, 283*, 106571.

Singh, S., & Acevedo, F. E. (2024). Grapevine plant defense responses associated with arthropod herbivory: A review. *Crop Protection, 177*, 106551.

Thomson, L. J., & Hoffmann, A. A. (2009). Vegetation increases the abundance of natural enemies in vineyards. *Biological Control, 49*, 259-269.

Wang, Z., Mound, L. E. A., Hussain, M., Arthurs, S. P., & Mao, R. (2022). Thysanoptera as predators: Their diversity and significance as biological control agents. *Pest Management Science, 78*, 5057-5070

War, A. R., Paulraj, M. G., Ahmad, T., Buhroo, A. A., Hussain, B., Ignacimuthu, S., & Sharma, H. C. (2012). Mechanisms of plant defense against insect herbivores. *Plant Signaling & Behavior, 7*, 1306-1320.

Yousif, A. A., & Hassan, W. A. (2023). HPLC analysis and antifungal activity of some plant extracts against decay apple fruits. *Iraqi Journal of Agricultural Sciences, 54*, 291-302.